Claims

1.   A method of tracking the resonant frequency of an electrically resonant structure comprising the steps of exciting the resonant structure with a reference signal of a variable frequency encompassing the possible resonant frequency of the resonant structure, mixing a response signal from the resonant structure with the reference signal, filtering the mixed response and reference signals to remove the sum products from the composite signal, and using the resulting amplitude modulation component of the response signal within a control loop to track the resonant frequency of the resonant structure.

2.   A method according to claim 1, comprising the further step of summing the reference signal from said oscillator with a second reference signal of a variable frequency encompassing the possible resonant frequency of a second resonant structure, the first and second resonant structures having a nominal difference frequency, exciting said first and second resonant structures with said mixed signal, mixing the composite response signal of said first and second resonant structures with the first reference signal, filtering the mixed signal and using the resulting signal within a control loop to track the resonant frequency of the first resonant structure, and mixing the composite response signal of said first and second structures with said second reference signal, filtering the mixed signal and using the resulting signal within a control loop to track the resonant frequency of the second resonant structure.

3.   A method according to claim 1 or claim 2, wherein the or each mixed response and reference signals are filtered using a low pass filter.

4.   A method according to any of the preceding claims, comprising the further step of suppressing the amplitude modulation of the or each reference signal by using a signal source of low output impedance.

5.   A method according to any of the preceding claims, wherein the or each reference signal passes through an impedance before exciting the or each resonant structure.

6.   A method according to any of the preceding claims, comprising the further step, for the or each reference signal, of mixing the response signal with a phase shifted version of the or each reference signal, filtering said mixed signal, squaring the filtered in-phase and phase shifted mixed response and reference signals, summing the associated squared signals and using the result within a control loop to provide a phase compensated track of the resonant frequency of the associated resonant structure.

7.   A method according to claim 6, wherein the reference signal is phase shifted through 90 degrees.

8.   An apparatus for tracking the resonant frequency of an electrically resonant structure, comprising a variable frequency oscillator providing an excitation signal of a variable frequency encompassing the possible resonant frequency of said resonant structure, coupling means connecting said variable frequency oscillator to said resonant structure, an I-mixer forming a synchronous detector having a first input connected to said oscillator and a second input connected to the coupling device, the I-mixer mixing the excitation signal from the variable frequency oscillator with a response signal generated by the resonant structure in response to the excitation signal, a filter connected to the output of the I-mixer which filters the output of the I-mixer to remove the sum products of excitation and response signals, thereby leaving just an amplitude modulation component of the signal, and processing means which processes the filtered signal to track the resonant frequency of the resonant structure.

9.   An apparatus according to claim 8 for tracking the resonant frequencies of a pair of electrically resonant structures having a nominal difference frequency, further

comprising a second variable frequency oscillator connected to the coupling means, said first variable frequency oscillator providing an excitation signal of a variable frequency encompassing the possible resonant frequency of the first resonant structure and said second variable frequency oscillator providing an excitation signal of a variable frequency encompassing the possible resonant frequency of the second resonant structure, a second I-mixer forming a synchronous detector associated with the second oscillator having its first input connected to the second oscillator and its second input connected to the coupling device so as to mix the excitation signal from the second oscillator with a composite response signal received from said first and second resonant structures, and a second filter connected to the output of the second I-mixer which filters the output signal.

10.   An apparatus according to claim 9, wherein said first and second resonant structure are connected in parallel.

11.   An apparatus according to claim 9 or claim 10, further including a summer having first and second inputs connected to the first and second oscillators respectively, and an output connected to the coupling means.

12.   An apparatus according to any of claims 8 to 11, wherein the or each filter is a low pass filter.

13.   An apparatus according to any of claims 8 to 12, further comprising an impedance connected between the or each oscillator and the coupling device, the first input of the or each I-mixer being connected between its associated oscillator and its impedance and the second input of the or each I-mixer being connected between the associated impedance and the coupling device.

14.   An apparatus according to any of claims 8 to 13, further including a Q-mixer associated with the or each oscillator having a first input connected to its associated

oscillator by means of phase shifting means and a second input connected to the coupling means such that the or each Q-mixer mixes a phase shifted version of the excitation signal from its associated oscillator with the response signal, a filter connected to the output of the or each Q-mixer which removes the sum products of the phase shifted excitation and response signals, so as to leave just an amplitude modulation component of the signal, and further including means associated with the or each oscillator for squaring and then summing the filtered signals from the I- and Q- mixers associated with the or each oscillator, said processing means processing the sum of the squares of the filtered signals from said I- and Q- mixers, whereby phase delay effects are eliminated.

15.   An apparatus according to claim 14, wherein the or each phase shifting means phase shifts the signal by 90 degrees.

16.   An apparatus according to claim 14 or claim 15, wherein said means for squaring and summing said signals comprises first analogue signal squaring means connected to the filtered output of the or each I-mixer, a second analogue squaring means connected to the filtered output of the or each Q-mixer, and a summer associated with the or each pair of I and Q mixer having a first and second inputs connected to the outputs of the associated first and second squaring means.

17.   An apparatus according to claim 16, wherein the said analogue signal squaring means each comprise a mixer having first and second inputs connected together to the output of its associated filter.

18.   An apparatus according to claim 14 or claim 15, wherein said means for squaring and summing the signals comprises a digital processor, the output of each filter being connected to an analogue to digital converter which is, in turn, connected to an input of the digital processor.

19.   An apparatus according to claim 18, wherein the or each digital processor also calculates first harmonic amplitudes of the demodulated signals and produces codes for controlling the carrier frequency of the signal source.

20.   An apparatus according to any of claims 8 to 19, wherein the coupling means is a rotational contactless coupler.